Recent Changes in the Atmospheric Heat Transport into the Arctic

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In recent decades near-surface air temperatures in the Arctic have risen much faster than the global average, known as Arctic amplification. Previous studies pointed to the importance of ice-albedo/ice-cloud feedbacks and the heat transport from mid-latitudes among others. However, there is no clear-cut picture as to their relative roles and contributions to the Arctic warming. This study focuses on the northward heat transport to the Arctic, one fundamental factor that can contribute to the Arctic warming and perhaps to the Arctic amplification, based on the ERA-Interim reanalysis data (Dee and Uppala, 2009). Here we estimate the heat transport globally and compare our estimates between two periods (1979-1988 versus 2001-2010) to see if there were any systematic changes occurred.

The results show that, for the annually averaged stationary component, the northward heat transport into the Arctic (>60°N) increased between the two periods, which was dominated by the dry static energy (DSE) component. In comparison, the change in the transient component was more restricted in mid-latitudes. Further analysis reveals that at 70°N approximately a two-thirds of this DSE change in the stationary component was associated with the change in the mean meridional circulation in the lower- and mid-troposphere with a large contribution coming from the summer months. The rest was related to the change in the stationary eddy component in winter, with a spatial pattern similar to the wave number 3-like structure in the upper troposphere. These results provide a clue as to seasonal characteristics for the links between the heat transport, circulation and ice-albedo feedback in the Arctic. We in particular discuss implications in terms of the relationship of this change in the energy transport into the Arctic to the seasonality in the ice-albedo feedback.

This constitutes a critical component within the research by the circulation subgroup of the Atmospheric Group in the GRENE Arctic project.